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## Identification and Significance of Innovation

NASA and other government agencies have been plagued by aeroelasticity of aircraft structures for a long time. The traditional approach has been to build stiff structures for suppressing aeroelastic effects. However, the increase in computational technology has enabled a careful analysis of aeroelastic effects, and design of lightweight structures. However, a direct CFD-CSD coupling is still too expensive to be used for control simulations and design. To address this critical need, IAI is developing reduced order models to capture the necessary physics, while enabling much more efficient computation. Our RACA approach will systematically study ROM technology and develop the appropriate methods for our particular application of interest – supersonic low-boom aircraft. We will develop a full-fledged aeroelastic analysis framework as well, to provide simulation-based verification results. The ROMs developed will then be used for control system design and demonstration of adaptive control technologies for advanced flexible aircraft.



Estimated TRL at beginning and end of contract: ( Begin: 1 End: 3 )

## Technical Objectives and Work Plan

**Technical Objectives and Work Plan:**
Objective 1: Setup of CFD and FEA solvers
Objective 2: Implementation of high-fidelity time-domain aeroelastic analysis
Objective 3: Development of POD-based and State Space ROMs
Objective 4: Use of ROMs for adaptive controller synthesis
**Outline of Phase I Tasks**
    Task 1 – Hold Kickoff Meeting and Establish Program Requirements.
    Task 2 – Setup High-Fidelity Aerodynamic Analysis.
    Task 3 – Setup High-Fidelity Structural and Dynamic Analysis.
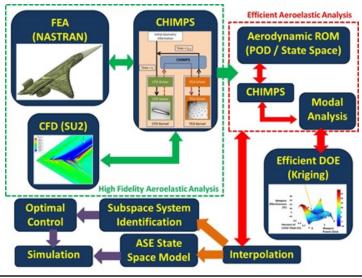    Task 4 – Develop High-Fidelity Aeroelastic Prediction Capability.
    Task 5 – Perform Reduced Order Modeling for Aerodynamics.
    Task 6 – Develop Modal Analysis Solution for Structures.
    Task 7 – Develop Automated Control Synthesis Technique.
    Task 8 – Demonstrate RACA Prototype.
    Task 9 – Develop Concepts for Phase II and Transition.

## NASA Applications

The proposed body of work addresses a critical need in NASA's repository of tools and techniques to develop high performance and supersonic civilian aircraft: a reliable physics-based simulation testbed to test different unconventional and advanced aircraft designs. This is directly relevant to programs such as Active Aeroelastic Wing (AAW), X-56A Multi-Utility Technology Testbed (MUTT), and Aeroservoelasticity (ASE) project in the High Speed Program.

## Non-NASA Applications

Other government agencies, such as AFRL have also been investigating aeroelastic concepts in collaboration with NASA and industry. The AAW and MUTT programs are specific examples of the above. Moreover, aircraft manufacturers interested in advanced aircraft need tools to allow rapid analysis of concepts across the entire flight envelope. RACA will provide the industry with such a capability.

## Firm Contacts

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